DEPARTMENT OF ELECTRICAL ENGINEERING

SCHEME -2023

SEMESTER-III

Shri Vile Parle Kelavani Mandal's

SHRI BHAGUBHAI MAFATLAL POLYTECHNIC

Learning and Assessment Scheme for Post S.S.C Diploma Programs

Program Name	: Diploma In Electrical Engineering		
Programme Code	: EE	**With Effect From Academic Year**	: 2023-24
Duration Of Programme	: 6 Semester	**Duration**	: 16 WEEKS
Semester	: III	**Scheme**	: 2023

Sr No	Course Title & Code	Course Type	IKS (Hrs)	Learning Scheme					Credits	Assessment Scheme								
				Actual Contact Hrs./Week			Self-Learning (SL^) (Term Work + Assignment) (Hrs)	Notional Learning Hrs /Week		Paper Duration (Hrs.)	Theory (Marks)			Based on LL & TL Practical (Marks)			Based on Self Learning	Total Marks
				CL	TL	LL					FA-TH	SA-TH	Total	FA-PR	SA-PR	SA-OR	SLA (Marks)	
1	C Programming (CPR230010)	AEC	3	2	-	4	-	6	3	-	-	-	-	25	50	-	-	75
2	Elements of Electronics (EOE230307)	DSC	-	3	-	2	1	6	3	3	30	70	100	25	25	-	25	175
3	Electrical Transmission & Distribution (ETD230308)	DSC	-	4	-	2	2	8	4	3	30	70	100	25	-	25	25	175
4	Electrical Circuits & Networks (ECN230309)	DSC	-	3	1	2	-	6	3	3	30	70	100	25	50	-	-	175
5	Transformers & Induction Motors (TIM230310)	DSC	-	4	-	2	2	8	4	3	30	70	100	25	50	-	25	200
6	Electrical & Electronic Measurements (EEM230311)	SEC	-	3	-	2	1	6	3	-	-	-	-	50	-	25	25	100
		Total	03	19	01	14	06	40	20	No.of Papers = 4	120	280	400	175	175	50	100	900

Abbreviations : IKS - Indian Knowledge System ,CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment, SA -Summative Assessment, SLA - Self Learning Assessment, TH-Theory, PR-Practical, OR-Oral **Legends :** @ Online Examination-

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+TL+LL+SL)Hrs. x 15 Weeks
5. 1 credit is equivalent to 30 Notional Hrs.
6. ^ Self learning hours shall not be reflected in the Time Table.
7. SA-PR,SA-OR: Assessed by Internal and External Examiners Jointly FA-PR, SLA: Assessed by Internal Examiner Only

Course Category : Discipline Specific Course Core (DSC) : 4, Discipline Specific Elective (DSE) : 0, Value Education Course (VEC) : 0, Intern./Apprenti./Project./Community (INP) : 0, Ability Enhancement Course (AEC) : 1, Skill Enhancement Course (SEC) : 1, Generic Elective (GE) : 0

Head of Department | **Controller of Examination** | **Secretary CDC** | **Principal**

SHRI BHAGUBHAI MAFATLAL POLYTECHNIC MUMBAI 400 056.

1. COURSE DETAILS

Programme: Electrical Engineering / Electronics and Telecommunications Engineering	**Semester: III / I**
Course: C Programming	**Course Category: AEC**
Course Code: CPR230010	**Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Learning Scheme				Credits	Assessment Scheme									
Actual Contact Hrs./Week			Self-Learning (SL^) (Term Work + Assignment) (Hrs)		Paper Duration (Hrs.)	Theory (Marks)			Based on LL & TL Practical (Marks)			Based on Self Learning	Total Marks
CL	TL	LL				FA-TH	SA-TH	Total	FA-PR	SA-PR	SA-OR	SLA (Marks)	
2	-	4	-	3	-	-	-	-	25	50	-	-	75

Total IKS Hrs for the Course: 03

3. COURSE OBJECTIVE

Automation Industry needs to build Microcontroller based application which are being developed using 'C'. This course deals with concepts of programming to enhance programming skill of diploma students. This course will enable the students to inculcate programming concepts and methodology to solve engineering problems.

4. SKILL COMPETENCY/INDUSTRY/EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

- **Develop applications using 'C'**

5. COURSE OUTCOMES (COs): At the end of the semester student will be able to**: -**

CO No.	COURSE OUTCOME
CO1	Draw algorithm using flowchart in Programming language.
CO2	Use of control flow statements in C.
CO3	Build C Programs with the help of Function , Array , Pointer , Structure and Union
CO4	Study of C Pre-processor & String handling

6. CO-PO, CO- PSO MAPPING TABLE - Electronics & Telecommunications Engineering /Electrical Engineering

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
C Programming (CPR230010)	CO1	1	1	3	1	-	1	1	2	2
	CO2	2	1	1	3	-	1	1	2	1
	CO3	3	2	1	1	-	1	1	-	-
	CO4	1	1	3	2	2	1	1	2	3
	CO Avg.	**1.75**	**1.25**	**2**	**1.75**	**2**	**1**	**1**	**2**	**2**

7. COURSE CONTENTS

UNIT NO.	TOPIC/Sub-topic	CO	Hrs
I	**Introduction to Programming** 1.1 Introduction 1.2 Why Programming? 1.3 What is Programming? 1.4 Why so many Programming language? 1.5 Introduction Flow chart & Algorithm	**CO1**	**02**
II	**Getting started with C** 2.1 What is C? 2.2 Constant, Variable & Keywords 2.3 Complication and Execution 2.4 Console IO Operations: printf , scanf 2.5 C Instruction 2.5.1 Type Declaration Instruction 2.5.2 Arithmetic Instruction 2.5.3 Control Instructions **Origin** – The cartography of India begins with early charts for navigation and constructional plans for buildings	**CO1**	**04**
III	**Control Flow Statement** 3.1 If statement 3.2 If-else Statement 3.3 Switch Statement 3.4 Unconditional Branching using go to statement 3.5 While Loop 3.6 Do While Loop 3.7 For Loop 3.8 Break and Continue	**CO2**	**08**

IV	**4.1 Function** 4.1.1 Introduction 4.1.2 Function declaration and Prototype 4.1.3 Scope of variable and storage classes 4.1.4 Pass by value & reference 4.1.5 Recursion **4.2 Array** 4.2.1 Introduction 4.2.3 Arrays Declaration and Initialization 4.2.3 One dimensional arrays 4.2.4 Two dimensional arrays. 4.2.5 Introduction to character arrays 4.2.6 Arrays as Function Parameters 4.3 **Pointers** 4.3.1 Introduction 4.3.2 Pointer Declarations, passing pointer to function 4.3.3 Dynamic memory allocation 4.3.4 Operations on pointers 4.3.5 Array of pointers.	**CO3**	**08**
V	**5.1 String Handling** 5.1.1 Introduction to Strings 5.1.2 Sample Program 5.1.3 Standard String Library Functions 5.1.4 Array of String **5.2 Structures and Unions** 5.2.1 Declaring and Instantiating Structures 5.2.2 Structure as Parameter and Pointer to Structure 5.2.3 Array of Structure 5.2.4 Union **5.3 The C Preprocessor** 5.3.1 Features 5.3.2 Macro Expansion 5.3.3 File Inclusion 5.3.4 Conditional Compilation 5.3.5 *#if* and *#elif* Directives	**CO4**	**08**
	GRAND TOTAL		**30**

8. LIST OF PRACTICALS/ASSIGNMENTS/ TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no of –10 Experiments/assignments/drawings.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx. Hrs required	CO
1	Introduction to C	2	CO1
2	To implement printf and scanf functions for user input -output	2	CO 1
3	To implement the working of identifier , constant and variables.	4	CO 1
4	To implement the working of arithmetic operators.	2	CO 1
5	To implement the working of relational & logical operators.	2	CO 1
6	To implement Implicit & Explicit type casting	2	CO 2
7	To implement the concept of if, if... else, conditional statements (two	4	CO 2

	problems each)		
8	To implement the concept of nested if, & else if... ladder conditional statements (two problems each)	2	CO 2
9	To implement the concept of switch...case statement(two problems each)	4	CO 2
10	To implement the concept of goto, break & continue statement	4	CO 2
11	To implement the concept of Loops i.e. while, for & do-while (two problems each)	4	CO 2
12	To implement the concept of one dimensional arrays (two problems each)	4	CO 3
13	To implement the concept of two dimensional arrays (two problems each)	4	CO 3
14	To implement the concept of string & it's various operations	4	CO 4
15	To implement the concept of user defined functions.	2	CO 3
16	To implement the concept of user defined functions with recursion	2	CO 3
17	To implement the concept of structures i.e. Arrays within structure & Arrays of structures	4	CO 3
18	To implement the concept of pointers	4	CO 3
19	To implement the concept of nesting of functions	4	CO 3
	TOTAL	60	

9. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Minimum number of practical/assignments.
3. Guest/Expert lectures
4. Demonstrations
5. Slides
6. Self-Learning Online Resources

10. SUGGESTED LEARNING RESOURCES

Sr.No.	Title of Book	Author	Publication
1	C Programming	Balaguru Swami	Tata McGrew Hill
2	Let Us C	Yashavant Kanetkar	BPB Publication
3	Programming with C	Byron Gottfried	Tata McGrew Hill, SCHAUM's series
4	Head First C	David Griffiths	O Really

11. LEARNING WEBSITE & PORTALS

1. http://www.tutorialspoint.com/cprogramming/
2. http://www.cs.cf.ac.uk/Dave/C/CE.html
3. http://www.technoexam.com/
4. http://www.thestudymaterial.com/c-c-programs.html
5. https://www.programiz.com/c-programming

12. ASSESMENT METHODOLOGIES/TOOLS

Formative Assessment (Assessment for Learning)

1. **Rubrics for COs Assignment**
2. **Term Work (FA-PR)**
3. **Seminar/Presentation**

Summative Assessment (Assessment of Learning)

1. **End Term Exam (SA-PR)**

13. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME
1	Internal	Mrs. A.A.Kulkarni
2	Internal	Mr. S.S.Rokade
3	External	Mr. U.J.Patel Organization: K.J.Somaiya ,Mumbai

1. COURSE DETAILS

Programme: Electrical Engineering	**Semester: III**
Course: Elements of Electronics	**Course Category: DSC**
Course Code: EOE230307	**Duration:16 Weeks**

2. LEARNING AND ASSESSMENT SCHEME

Learning Scheme				Credits	Assessment Scheme								
Actual Contact Hrs./Week			Self-Learning (SL) (Term Work + Assignment) (Hrs)		Paper Duration (Hrs.)	Theory (Marks)			Based on LL & TL			Based on Self Learning	Total Marks
									Practical (Marks)				
CL	TL	LL				FA-TH	SA-TH	Total	FA-PR	SA-PR	SA-OR	SLA (Marks)	
3	-	2	1	3	3	30	70	100	25	25	-	25	175

3. COURSE OBJECTIVE

In present era the field of electronics plays an important role in almost every sphere of our life. It has penetrated in every field of engineering.

It is therefore necessary for an engineer to study the electronic components, their characteristics and applications.

4. SKILL COMPETENCY/INDUSTRY/EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified competency through the teaching learning experiences:

- Maintain electronic circuits comprising of discrete electronic components
- Interpret datasheet of electronic components.

5. COURSE OUTCOMES (COs): At the end of the semester student will be able to**: -**

CO No.	COURSE OUTCOME
CO1	Identify applications of various diodes in electrical and electronic circuits.
CO2	Use BJT and its biasing techniques for amplification, switching and inversion in circuit.
CO3	Interpret the working and applications of FETs in electrical and electronic circuits.
CO4	Select and use appropriate amplifier for required application.
CO5	Use regulated power supply in electronic applications.

6. CO-PO, CO- PSO MAPPING TABLE

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Elements of Electronics (EOE230307)	CO1	3	2	1	2	-	-	-	2	1
	CO2	3	2	2	2	-	-	-	2	1
	CO3	3	1	1	1	-	-	-	2	1
	CO4	3	1	1	1	1	-	-	2	1
	CO5	3	1	1	1	1	-	-	2	1
	CO Avg.	3	1.40	1.20	1.40	1	-	-	2	1

7. COURSE CONTENTS

UNIT NO.	TOPIC/Sub-topic
I	**Semiconductor Physics** 1.1 Introduction: Conductor, Semi-Conductor and insulator 1.2 Intrinsic and Extrinsic Semiconductor, doping, charge carriers 1.3 Semiconductor diode (P-N Junction)-working under unbiased, forward bias and reverse biased condition & V-I Characteristics 1.4 **Zener diode**: Construction, symbol, working, characteristics and its application 1.5 **Photo diode**: Construction, working principle, characteristics and application 1.6 **LED**: Construction, working principle, characteristics and application 1.7 **Diode applications**: Rectifiers: Half Wave Rectifier (HWR) and Full Wave rectifier (FWR), their working with waveforms and their expression of average and RMS voltage and current, ripple factor, efficiency (No derivation expected), simple numerical Filter: Types: C, L, CLC (π). Their advantages and disadvantages.
II	**Bipolar Junction Transistor** 2.1 Construction, symbol and working principle of NPN and PNP transistor 2.2 Characteristics of CB, CE and CC Configuration 2.3 Transistor Parameter-Input resistance, Output resistance α & β and relation between them. (basic numerical) 2.4 Concept of transistor as a Switch 2.5 Transistor as an Amplifier 2.6 Transistor as an Inverter 2.7 Need of biasing circuits 2.8 Different types of biasing: (simple numerical) Fixed-Bias Circuit, Emitter-Stabilized Bias Circuit, Voltage-Divider Bias

III	**Field Effect Transistor** 4.1 Construction and working of P and N channel type (JFET) 4.2 Types of JFET and MOSFET, symbol and characteristics 4.3 Application of FET 4.4 Comparison of BJT, FET & MOSFET.
IV	**Small Signal Amplifier** 5.1 Concept, need and gain of Amplifier 5.2 Voltage gain (No derivation) 5.3 Single stage CE amplifier 5.4 Frequency response of Single Stage CE amplifier 5.5 Multistage Amplifier (Cascaded Amplifier) 5.6 Types of Amplifier Coupling-Direct, RC and transformer coupling 5.7 RC Phase Shift Oscillator Need and Importance
V	**Regulated Power Supply** 6.1 Need of Regulator 6.2 Concept of Load and line regulation 6.3 Zener Diode as a voltage regulator 6.4 Regulator IC 78XX,79XX (Simple numerical)

8. LIST OF PRACTICALS/ASSIGNMENTS/ TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no of 10 Experiments/assignments/drawings.

Sr. No.	Title of Experiment/Assignment/ Exercise/Tutorial/Drawings	Approx. Hrs. required	CO
1	Measurement of amplitude and frequency using CRO	2	CO1
2	Plot P-N junction diode characteristics	2	CO1
3	Plot Zener diode characteristics	2	CO1
4	Test performance of half wave rectifier	2	CO1
5	Test performance of full wave rectifier	2	CO1
6	Use and understand the need of LC and π filter in electronics	2	CO1
7	Identify the Terminals of NPN and PNP transistors	2	CO2
8	Plot Characteristics of BJT in CE configuration	2	CO2
9	Plot CE Amplifier characteristics	2	CO2
10	Find Frequency response of CE Amplifier	2	CO2
11	Plot FET Characteristics	2	CO3
12	Understand Two Stage RC Coupled Amplifier	2	CO4
13	Study RC Phase Shift Oscillator	2	CO4
14	Verify Zener diode as a voltage regulator	2	CO5
15	Test and Troubleshoot the performance of 78XX regulator IC's	2	CO5
	TOTAL	30	

9. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITES FOR SPECIFIC LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

Assessment to be based on one of the following tools and rubrics for evaluation of SLA to be well defined by course teacher.

1. **Assignments**
   Assignments will be given on following chapter and students will solve it in a notebook. The notebook will be assessed at the end of the semester.
   1. Semiconductor Physics
   2. Bipolar Junction Transistor
   3. Field Effect Transistor
   4. Small Signal Amplifier
   5. Regulated Power Supply

2. **Chart making**
   Charts of diode, BJT, FET construction, biasing, amplifiers, regulators.

10. IMPLEMENTATION STRATEGY (PLANNING)

1 Teaching Plan
2 Minimum no of practical/assignments.
3 Industry visit
4 Guest/Expert lectures
5 Slides
6 Self-Learning Online Resources

11. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Electronics Devices and Circuits	Robert Boylestad Louis Nashelsky	Prentice Hall
2	Basic Electronics and Linear Circuits	N. N. Bhargava, D. C. Kulshreshtha, S. C. Gupta-TTTI Chandigarh	Tata McGraw Hill
3	Basic Electronics	Grob Bernard	Tata McGraw Hill
4	Principles of Electronics	V. K. Mehta	S.Chand

12. LEARNING WEBSITE & PORTALS (minimum 5)

1. http://electronicsforu.com/
2. http://www.electronicshub.org/
3. http://electronicdesign.com/
4. https://www.allaboutcircuits.com/
5. https://onlinecourses.nptel.ac.in/noc23_ee62/preview

13. ASSESMENT METHODOLOGIES/TOOLS

Formative Assessment (Assessment for Learning)

1. Test
2. Rubrics for COs Assignment
3. Self-Learning
4. Term Work

Summative Assessment (Assessment of Learning)

1. End Term Exam
2. Practical Exam

14. SUGGESTED WEIGHTAGE FOR LEARNING EFFORTS & ASSESMENT PURPOSE (Specification Table)

Unit No.	Unit Title	Aligned COs	Teaching Hours	Distribution of Theory Marks			
				R Level	U Level	A Level	Total Marks
I	Semiconductor Physics	CO1	10	4	4	6	14
II	Bipolar Junction Transistor	CO2	14	6	8	8	22
III	Field Effect Transistor	CO3	08	4	4	6	14
IV	Small Signal Amplifier	CO4	08	2	2	8	12
V	Regulated Power Supply	CO5	05	-	4	4	08
	TOTAL		**45**	**16**	**22**	**32**	**70**

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

15. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME
1	Internal	Ms. Urvi Sawant
2	Internal	Mr. N. D. Adate
3	External	Mrs. Ashwini Patil
		Organization: Government Polytechnic, Bandra, Mumbai

1. COURSE DETAILS:

Programme: Electrical Engineering	**Semester: III**
Course: Electrical Transmission &Distribution	**Course Category: DSC**
Course Code:ETD230308	**Duration:16 Weeks**

2. LEARNING AND ASSESSMENT SCHEME

Learning Scheme				Credits	Assessment Scheme								
Actual Contact Hrs./Week			Self-Learning (SL^) (Term Work + Assignment) (Hrs)		Paper Duration (Hrs.)	Theory (Marks)			Based on LL & TL			Based on Self Learning	Total Marks
									Practical (Marks)				
CL	TL	LL				FA-TH	SA-TH	Total	FA-PR	SA-PR	SA-OR	SLA (Marks)	
4	-	2	2	4	3	30	70	100	25	-	25	25	175

3. COURSE OBJECTIVE

This Course deals with various components and types of transmission and Distribution system, performance of various types of transmission lines. It also deals with various types of Substation, underground cables their faults and various methods to maintain it This course will be very useful for understanding the other higher level courses like switchgear and Protection in further study.

4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

- **Identify various components and types of Transmission and distribution systems.**
- **Understand different types of Substation, Transmission lines and Underground cables.**

5. COURSE OUTCOMES (COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME
CO1	Explain various components and types of transmission systems.
CO2	Identify various components and types of distribution systems. .
CO3	Understand performance of transmission line w.r.to load change.
CO4	Explain underground cables their faults and tests
CO5	Understand different types of Substation, equipment of substation and layout of Substation.

6. CO-PO, CO- PSO MAPPING TABLE

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Electrical Transmission and Distribution (ETD230308)	CO1	3	-	-	-	-	1	2	2	2
	CO2	3	-	-	-	-	2	1	2	2
	CO3	3	-	2	-	-	1	1	2	2
	CO4	1	2	-	3	-	-	-	2	2
	CO5	1	-	-	-	2	3	1	2	2
	CO Avg.	2.20	2.00	2.00	3.00	2.00	1.75	1.25	2.0	2.0

7. COURSE CONTENTS

UNIT NO.	TOPIC/Sub-topic
I	**Introduction to Transmission systems** 1.1 Introduction to transmission. 1.2 Necessity of transmission of electricity 1.3 Classification & comparison of different Transmission system. 1.4 Introduction to line components. 1.5 Types of conductors-copper, Aluminium Galvanised steel, Cadmium copper solid, stranded & bundled conductors 1.6 Line supports- requirements, types, and field, Applications. 1.7 Line insulators-requirements, types, and field, Applications. 1.8 Failure of insulator and reasons for Failure. 1.9 Distribution of potential over a string of Suspension insulators. 1.10 Concept of string efficiency, methods of Improving string efficiency. 1.11 Corona-corona formation, disadvantages, factors affecting corona, Important terms related to corona. 1.12. Introduction of Sag in Overhead Transmission line 1.13 calculation of Sag when Supports are at equal Level, Supports are at unequal Level, Effect of wind and ice loading (numerical based on 1.9 , 1.13)
II	**Performance of Transmission line.** 2.1Transmission Line Parameters 2.1.1 R,L & C of 1-ph & 3-ph transmission line & their Effects on line. 2.1.2 Skin effect, Proximity effect & Ferranti effect. 2.2 Classification of transmission lines. 2.3 Losses, efficiency & regulation of line. 2.4 Performance of single phase short transmission Line (numericals based on it) 2.5 Effect of load power factor on performance of transmission lines. 2.6 Performance of Medium transmission Lines- 1.End condenser method

	2.Nominal T method 3.Nominal π method
III	**Extra High Voltage Transmission.** 3.1 Introduction and Requirement. 3.2 EHVAC Transmission. 3.3 Reasons for adoption & limitations. 3.4 HVDC Transmission-Advantages, Limitations. 3.5 Comparison of EHVAC Transmission line with HVDC Transmission
IV	**Components of Distribution System** 4.1 Introduction of distribution system. 4.2 Classification of distribution system. 4.3 Requirement of distribution system. 4.4 Design consideration of distribution system 4.5 D.C. Distributors and its types 4.6 D.C. Distribution calculations for Voltage drop. 4.7 A.C.Distribution 4.7.1 Introduction of A.C. distribution system. 4.7.2 Classification of AC distribution system (Radial,Ring,Mesh) 4.7.3 A.C. Distribution Calculations 4.7.4 Methods of Solving AC Distribution Problems (Numerical based 4.6,4.7.3)
V	**Underground cables.** 5.1 Requirements of Underground Cable 5.2Construction of Underground Cable 5.3 Insulating materials used for Cables (Properties and different materials used such as Rubber, Vulcanised India Rubber, Impregnated paper, Varnish Cambric, PVC). 5.4 Classification of cables 5.4.1 Construction of –Belted cables, Screened Cables, Pressure Cables, Gas Pressure Cables 5.5 Comparison of Underground cable with overhead lines. 5.6 Cable laying(Direct laying, Draw in System) 5.7 Cable faults. 1. Types of fault 2. Varley loop Test 3.Murray loop Test
VI	**Substations.** 6.1 Introduction and Factors considered while designing substation. 6.2 Classification of Substation(according to Service Requirement and Constructional features) 6.3 Comparison of Indoor and Outdoor substation 6.4. Construction and Operation of (Transformer Substation, Pole-Mounted Substation, Underground Sub-Station) 6.5 Equipment and circuit elements of substations. In coming & outgoing lines, Transformers, CT & PT, Bus bar Relays, Circuit Breaker, fuses, Isolators, lightning arresters, Insulators. (only symbols and function) 6.6 Key diagram of 11KV/400 V Substation.

8. LIST OF DRAWING SHEETS:

Term Work consists of minimum no of Five Drawing Sheets.

Sr. No.	Title of Drawing Sheet	Approx.Hrs required	COs
1.	Types of Transmission systems	6	CO1
2.	Components of Transmission System	6	CO1
3.	Performance of Transmission line.	4	CO3
4.	Components of Distribution System	6	CO2
5.	Types of Underground cables.	4	CO4
6.	Components and different types of Substations	4	CO5
	Total	30 Hrs	

9. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITES FOR SPECIFIC LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

1. Seminar/Presentation
2. Model/Chart making
3. Assignment
4. Case Study
5. Quiz

Assignments-

- Solve numericals based on Distribution of potential over a string of Suspension insulators.
- Solve numericals based on calculation of Sag when Supports are at equal Level, Supports are at unequal Level, Effect of wind and ice loading
- Solve numericals based on Performance of single phase short transmission line
- Solve numericals based on A.C. and D.C. Distribution calculations for Voltage drop.
- Comparison of Underground cable with overhead lines.

Model/Chart making –

- Prepare a chart for showing Different types of Line supports
- Prepare a chart for showing Different types of Insulator
- Prepare a chart for showing Different types of transmission lines (Vector diagrams)
- Prepare a chart for showing Different types of DC and AC distribution system
- Prepare a chart for showing Different types of Substations and Key diagram of 11KV/400 V Substation.

10. IMPLEMENTATION STRATEGY(PLANNING)

1. Teaching Plan.
2. Minimum number of Drawings/Assignments.
3. Industry visit.
4. Guest/Expert lectures.
5. Demonstrations.
6. Slides.
7. Self-Learning Online Resources

11. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Electrical Power system	V.K Mehta	s.chand publication
2	Electrical Power	S.L Uppal	Khanna publication
3	Electrical Power	Soni, Gupta & Bhatnagar	Dhanpatrai & sons
4	Electrical Power	J.B.Gupta	Khanna Publication

12 LEARNING WEBSITE & PORTALS

1.www.tatapowerindia.com
2.www.mahagenco.com
3.www.relance.com
4. www.electrical-technologies.com/
5. www.electrical4u.com.

13. ASSESMENT METHODOLOGIES/TOOLS

Formative Assessment (Assessment for Learning)

1. Test
2. Rubrics for COs Assignment
3. Self-Learning
4. Term Work

Summative Assessment (Assessment of Learning)

1. End Term Exam
2. Oral Exam

14. SUGGESTED WEIGHTAGE FOR LEARNING EFFORTS & ASSESMENT PURPOSE (Specification Table)

Unit No.	Unit Title	Aligned COs	Learning Hours	Distribution of Theory Marks			
				R Level	U Level	A Level	Total Marks
I	Introduction to Transmission system	CO1	14	4	8	4	16
II	Performance of Transmission line.	CO3	14	8	6	2	16
III	Extra High Voltage Transmission.	CO1	04	-	4	-	04
IV	Components of Distribution System	CO2	12	4	6	4	14
V	Underground cables	CO4	08	2	4	4	10
VI	Substations.	CO5	08	5	5		10
TOTAL			**60**	**23**	**33**	**14**	**70**

R Remembering, U Understanding, A Applying, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs.The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

15.COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME
1	Internal	Mrs Ajayshree N. Kinhekar
2	Internal	Mr. N.D.Adate
3	External	Mrs. Bhagyashree Firake
		Organisation:K.J.Smaiya Polytechnic

1. **COURSE DETAILS**

Programme: Electrical Engineering	**Semester: III**
Course: Electrical Circuits & Networks	**Course Category: DSC**
Course Code: ECN230309	**Duration: 16 Weeks**

2. **LEARNING AND ASSESSMENT SCHEME**

Learning Scheme				Credits	Assessment Scheme								
Actual Contact Hrs./Week			Self-Learning (SL^) (Term Work + Assignment) (Hrs)		Paper Duration (Hrs.)	Theory (Marks)			Based on LL & TL			Based on Self Learning	Total Marks
									Practical (Marks)				
CL	TL	LL				FA-TH	SA-TH	Total	FA-PR	SA-PR	SA-OR	SLA (Marks)	
3	1	2	-	3	3	30	70	100	25	50	-	-	175

3. **COURSE OBJECTIVE**

This Course deals with the Different circuit elements, Transformation techniques, Network Theorems, Analysis of two port network and practical's thereof. In order to understand electrical machines, power system, controls and measurements, knowledge of electrical circuit and network is very important. Study of electrical network lays the foundation to understand Courses of application level.

4. **SKILL COMPETENCY/INDUSTRY/EMPLOYER EXPECTED OUTCOME**

- **Diagnose the electrical and electronic circuit problems**

5. **COURSE OUTCOMES (COs)** At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME
CO1	Identify circuit elements and use circuit transformation techniques
CO2	Use principles of circuit analysis to troubleshoot electric circuits
CO3	Apply network theorems to troubleshoot electric circuits.
CO4	Interpret Graph theory used to solve electrical networks
CO5	Explain and evaluate transient behavior of RC and RL circuit
CO6	Analyze two port network for T and π networks

6. CO - PO, CO - PSO MAPPING TABLE

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Electrical circuits & Networks (ECN230309)	CO1	3	2	1	2	-	-	-	2	3
	CO2	1	3	2	1	-	-	-	2	3
	CO3	3	2	1	1	-	-	-	2	3
	CO4	1	3	2	1	-	-	-	2	3
	CO5	3	2	2	1	-	-	-	2	3
	CO6	3	2	2	1	-	-	-	2	3
	CO Avg	**2.33**	**2.33**	**1.67**	**1.17**	**-**	**-**	**-**	**2.00**	**3.00**

7. COURSE CONTENTS

UNIT NO.	TOPIC/Sub-topic
I	**Circuit Elements and Transformation Techniques** 1.1 Classification of circuit elements, unilateral, bilateral, linear, non-linear, lumped, distributed passive & active circuit elements. 1.2 Types of sources 1.2.1 Ideal voltage source and Practical voltage source 1.2.2 Ideal current source and Practical current source 1.3 Source transformation Technique. 1.4 Star delta transformation for resistance. Numerical on the above topics
II	**Circuit Analysis Methods** 2.1 Kirchhoff's voltage Law 2.2 Kirchhoff' current Law 2.3 Mesh Current Analysis using KVL 2.4 Node Voltage Analysis using KCL Numerical on the above topics
III	**Network Theorems.** 3.1 Superposition Theorem 3.2 Thevenin's Theorem 3.3 Norton's Theorem 3.4 Maximum Power Transfer Theorem 3.5 Reciprocity theorem Numerical on the above topics

IV	**Graph Theory** 4.1 Graph of a network 4.2 Types of Graphs 4.2.1 Connected Graph 4.2.2 Unconnected Graph 4.2.3 Directed Graph 4.2.4 Undirected Graph 4.3 Subgraph and its Types 4.3.1 Tree 4.3.2 Co-Tree 4.4 Matrices associated with Network Graphs 4.4.1 Incidence Matrix 4.4.2 Fundamental Loop Matrix 4.4.3 Fundamental Cut-Set Matrix 4.5 Duality Simple Numerical on above topics.
V	**D.C Transient Response.** 5.1 R-L transients. Expression for the rise and decay of current in simple R-L series circuit. 5.2 Initial conditions, time constant in R-L transient 5.3 Expression for energy stored in inductance. 5.4 R-C-transients. Expression for the rise and decay of current, charge and voltage in simple R-C series circuit. 5.5 Initial conditions, time constant in R-C transient 5.6 Expression for energy stored by a capacitor. Numerical on the above topics
VI	**Two Port Network Analysis.** 6.1 Impedance, admittance, hybrid and ABCD parameters. 6.2 Condition of Reciprocity for all above parameters 6.3 Condition of Symmetry for all above parameters 6.4 Calculation of Z, Y, h and ABCD parameters for T Network

8. LIST OF PRACTICALS/ASSIGNMENTS/TUTORIALS/DRAWINGS

Term work consist of Journal containing minimum number of 10 Experiments/assignments/drawings

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx. Hrs required	CO
1	To Verify Star Delta Transformation technique	4	CO1
2	Assignment on Circuit Analysis Methods	-	CO2

3	To Verify Superposition theorem with DC Source	4	CO3
4	To Verify Thevenin's theorem in DC Circuits	4	CO3
5	To Verify Norton's theorem in DC Circuits	4	CO3
6	To Verify Maximum power transfer theorem in DC Circuits	4	CO3
7	To Verify Reciprocity theorem in DC Circuits	2	CO3
8	Assignment on Matrices associated with network graphs	-	CO4
9	To determine the time constant of RC circuit during discharging of capacitor	2	CO5
10	To calculate and verify Z parameter of two port network	2	CO6
11	To calculate and verify Y parameter of two port network	2	CO6
12	To calculate and verify H parameter of two port network	2	CO6
13	Assignment on Z, Y, h and ABCD parameters	-	CO6
TOTAL		30 Hrs	

9. IMPLEMENTATION STRATEGY(PLANNING)

1 Teaching Plan.

2 Minimum number of Practicals/Assignments.
3 Guest/Expert lectures.
4 Slides
5 Demonstrations.
6 Self-Learning Online Resources

10. SUGGESTED LEARNING RESOURSES

Sr.	Title of Book	Author	Publication
1	Electrical Technology.Volume-1	B.L.Thereja	S.Chand & Co.
2	Network Analysis and Synthesis	C.L.Wadhwa	New Age international
3	Network Analysis	Van Valkenburg	PHI Learning
4	Circuit Analysis	B Subramanyam	I K International Publishing House Pvt. Ltd ISBN-13 : 978-8189866440

11. WEB REFERENCES

1. www.nptel.ac.in/courses/108105053/7
2. www.electricaltechnology.org
3. www.electrical4u.com
4. https://www.maplesoft.com/content/EngineeringFundamentals
5. https://circuitglobe.com/

12. ASSESMENT METHODOLOGIES/TOOLS

Formative Assessment (Assessment for Learning)

1. Test
2. Rubrics for COs Assignment
3. Self-Learning
4. Term Work

Summative Assessment (Assessment of Learning)

1 End Term Exam
2. Oral Exam

13. SUGGESTED WEIGHTAGE FOR LEARNING EFFORTS & ASSESMENT PURPOSE (Specification Table)

Unit No.	Unit Title	Aligned COs	Learning Hours	Distribution of Theory Marks			
				R Level	U Level	A Level	Total Marks
I	Circuit Elements and Transformation Techniques	CO1	10	4	4	4	12
II	Circuit Analysis Methods	CO2	08	2	4	4	10
III	Network Theorems	CO3	12	4	4	6	14
IV	Graph Theory	CO4	10	2	4	4	10
V	D.C Transient Response	CO5	10	4	6	4	14
VI	Two Port Network Analysis.	CO6	10	2	4	4	10
TOTAL			60	18	26	26	70

R- Remembering, U - Understanding, A- Applying (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs.The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

14. COURSE EXPERT COMMITTEE MEMBERS

SR.NO.		NAME
1	Internal	Mr.Dinesh G Rajmandai
2	Internal	Miss Urvi Sawant
3	External	Mrs. Ashivini Patil
		Organization: Government Polytechnic, Mumbai

1. COURSE DETAILS

Programme: Electrical Engineering	**Semester: III**
Course: Transformer & Induction motor	**Course Category: DSC**
Course Code: TIM230310	**Duration:16 Weeks**

2. LEARNING AND ASSESSMENT SCHEME

Learning Scheme				Credits	Assessment Scheme								
Actual Contact Hrs./Week			Self-Learning (SL^) (Term Work + Assignment) (Hrs)		Paper Duration (Hrs.)	Theory (Marks)			Based on LL & TL			Based on Self Learning	Total Marks
									Practical (Marks)				
CL	TL	LL				FA-TH	SA-TH	Total	FA-PR	SA-PR	SA-OR	SLA (Marks)	
4	-	2	2	4	3	30	70	100	25	50	-	25	200

3. COURSE OBJECTIVE

This subject deals with transformer and induction motor, their concept, principle and operation. Transformer is a very vital link in power system and induction motor is cheapest motor available in general purpose motors. The knowledge and skill obtained by the student will be useful to him as a supervisor or technician in performing the technical function.

4. SKILL COMPETENCY/INDUSTRY/EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified competency through the teaching learning experiences:

- Perform various tests on induction motors and transformers
- Select the proper type of transformer and starting, speed control methods for induction motor for various industrial applications.

5. COURSE OUTCOMES (COs): At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME
CO1	Determine equivalent circuit parameters, efficiency and regulation of transformer by performing appropriate tests on the single phase transformer.
CO2	Justify the need of auto transformer.
CO3	Choose the type of connection and vector group of three phase transformer for specific application.
CO4	Calculate slip, speed, torque and parameters of equivalent circuit of 3 phase induction motor by performing appropriate tests on the same and through circle diagram.
CO5	Select the type of starters, speed control method for given application.
CO6	Identify the methods of starting single phase induction motors.

6. CO-PO, CO- PSO MAPPING TABLE

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Transformer & Induction Motor (TIM230310)	CO1	3	1	1	2	1	-	1	3	3
	CO2	3	1	-	1	-	-	-	3	3
	CO3	3	1	1	-	-	-	-	3	3
	CO4	3	2	1	2	-	-	-	3	3
	CO5	3	1	1	2	1	-	-	3	3
	CO6	3	-	1	-	-	-	-	3	3
	CO Avg.	3.00	1.20	1.00	1.75	1.00	-	1.00	3.00	3.00

7. COURSE CONTENTS

UNIT NO.	TOPIC/Sub-topic
I	**Single Phase Transformers** 1.1. Working principle, need and role of transformer 1.2. Basic construction, types, comparison and classifications of transformer 1.3. E.M.F. Equation 1.4. Transformation ratio and rating 1.5. Polarity of transformer 1.6. Ideal transformer, assumptions on no load and on load at different power factor, vector diagram 1.7. Practical transformer on no load and on load at different power factor, vector diagram 1.8. Equivalent circuit of a Transformer 1.9. Transformer losses 1.10. Open circuit test and short circuit test, Determination of the equivalent parameters from a OC/SC test 1.11. Equivalent circuits referred to any side (HV & LV side) 1.12. Voltage regulation and Efficiency of a transformer by: OC and SC test Load test 1.13. condition for maximum efficiency 1.14. Distribution and power Transformer 1.15. All day efficiency 1.16. Per unit impedance, per unit reactance, per unit resistance (Numerical based on above)
II	**Autotransformer** 2.1. Concept of Autotransformer 2.2. comparison with 2 winding transformer & potential divider 2.3. Copper saving 2.4. Advantages and disadvantages of auto-transformer, Uses

III	**Three Phase Transformers** 3.1. Construction of three phase transformer 3.2. Bank of Three single phase Transformers 3.3. Single unit of three phase Transformer 3.4. Three phase transformer connections and vector group 3.5. Cooling methods three phase transformer connections 3.6. Indian standards list for transformers
IV	**Three Phase Induction Motor** 4.1. Rotating magnetic field 4.2. Induction motor as generalized transformer 4.3. Construction, types and principle of three phase induction motor 4.4. Concept of slip & equation for rotor current, rotor e.m.f, Effect of slip 4.5. Torque equation, Condition for maximum torque 4.6. Torque-speed, Torque-slip curve, Full load torque and starting torque and maximum torque 4.7. Effect of change in rotor circuit resistance and supply voltage on torque-slip 4.8. Power stages of three phase Induction Motor Numerical based on above (4.4 to 4.8) 4.9. No-load, block rotor and direct load test 4.10. Equivalent circuit of an induction motor
V	**Starting and Speed Control of Induction Motors** 5.1. Necessity of starter for an induction motor 5.2. Starter for induction motor- Types, selection, comparison DOL, Stator resistance type, rotor resistance type, auto transformer type, star-delta type starters 5.3. Speed Control Methods: 5.3.1 Rotor rheostat control, 5.3.2 pole changing method, 5.3.3 Frequency changers and stator voltage.
VI	**Single Phase Induction Motor** 6.1. Double Field revolving theory and cross field theory 6.2. Construction, working principle and applications of 6.2.1 Resistance start induction run 6.2.2 Capacitor start induction run motor 6.2.3 Capacitor start and capacitor run motor

8. LIST OF PRACTICALS/ASSIGNMENTS/ TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no of 10 Experiments/assignments/drawings.

Sr. No.	Title of Experiment/Assignment/ Exercise/Tutorial/Drawings	Approx. Hrs. required	CO
1	To verify turns ratio of single phase transformer	2	CO1
2	To perform Open circuit test on single phase transformer	2	CO1
3	To perform Short circuit test on single phase transformer	2	CO1
4	To perform Load test on single phase transformer	4	CO1
5	To verify turns ratio of auto transformer	2	CO2
6	To study Three phase transformers: Basic configuration	2	CO3
7	Demonstration of DOL starter and starting of 3 phase induction motor using DOL starter	2	CO5
8	To start 3 phase induction motor using Auto-transformer	2	CO5
9	To study Star-delta starter for 3 phase induction motor	2	CO5
10	To perform No load and blocked rotor test on 3 phase induction motor	4	CO4
11	To perform Direct Load test on 3 phase induction motor	4	CO4
12	To study single phase induction motor	2	CO6
	TOTAL	30	

9 SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITES FOR SPECIFIC LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

Assessment to be based on one of the following tools and rubrics for evaluation of SLA to be well defined by course teacher.

1. Assignments

Assignments will be given on following chapter and students will solve it in a notebook. The notebook will be assessed at the end of the semester.

1. Single Phase Transformers
2. Autotransformer
3. Three Phase Transformers
4. Three Phase Induction Motor
5. Starting and Speed Control of Induction Motors
6. Single Phase Induction Motor

2. Chart making

Charts of transformer, auto transformer, three phase transformer, induction motors.

10. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Minimum no of practical/assignments.
3. Industry visit
4. Guest/Expert lectures
5. Slides
6. Self-Learning Online Resources

11. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Electrical Technology Vol – II	Theraja B. L. Theraja A. K.	S. Chand Co. New Delhi ISBN 10:8121924375
2	Electrical Machinery	Dr. P. S. Bimbra	Khanna Publishers
3	Theory and Performance of Electrical Machines	J. B. Gupta	Dhanpatrai & sons
4	Electrical Machines	Ashfaque Hussain	Khanna Publications

12. LEARNING WEBSITE & PORTALS (minimum 5)

1. www.nptel.iitm.ac.in
2. www.howstubworks.com
3. www.electrical4u.
4. www.electricalnotesandarticles.co.in
5. www.electricalportal.com.

13. ASSESMENT METHODOLOGIES/TOOLS

Formative Assessment (Assessment for Learning)

1. Test
2. Rubrics for COs Assignment
3. Self-Learning
4. Term Work

Summative Assessment (Assessment of Learning)

1. End Term Exam
2. Practical Exam

14. SUGGESTED WEIGHTAGE FOR LEARNING EFFORTS & ASSESMENT PURPOSE (Specification Table)

Unit No.	Unit Title	Aligned COs	Teaching Hours	Distribution of Theory Marks			
				R Level	U Level	A Level	Total Marks
I	Single Phase Transformers	CO1	18	6	6	8	20
II	Autotransformer	CO2	03	-	6	-	06
III	Three Phase Transformers	CO3	06	3	4	-	07
IV	Three Phase Induction Motor	CO4	18	6	6	8	20
V	Starting and Speed Control of Induction Motors	CO5	09	3	3	4	10
VI	Single Phase Induction Motor	CO6	06	-	4	3	07
	TOTAL		**60**	**18**	**29**	**23**	**70**

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

15. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME
1	Internal	Ms. Urvi Sawant
2	Internal	Mr. N.D.Adate
3	External	Mr. A. K. Dhulshette
		Organization: Government Polytechnic, Bandra, Mumbai

1. COURSE DETAILS:

Programme : Electrical Engineering	**Semester : III**
Course: Electrical & Electronic Measurements	**Course Category: SEC**
Course Code: EEM230311	**Duration : 16 Weeks**

2. LEARNING AND ASSESSMENT SCHEME

Learning Scheme				Credits	Assessment Scheme								
Actual Contact Hrs./Week			Self-Learning (SL^) (Term Work + Assignment) (Hrs)		Paper Duration (Hrs.)	Theory (Marks)			Based on LL & TL			Based on Self Learning	Total Marks
									Practical (Marks)				
CL	TL	LL				FA-TH	SA-TH	Total	FA-PR	SA-PR	SA-OR	SLA (Marks)	
3	-	2	1	3	3	-	-	-	50	-	25	25	100

Total IKS Hrs for the course :00

3. COURSE OBJECTIVE

The said course is classified as a core domain as an electrical engineering working with the industry will be in position to function as a Supervisor need to be familiarized with various techniques of measurements and also should be in a position to measure various electrical and parameters like voltage, current, resistance, inductance etc. using analog and digital instruments

4. SKILL COMPETENCY/INDUSTRY/EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified competency through various teaching-learning experiences:

- **Troubleshoot electrical and electronics measuring instruments used for laboratory and industrial measurements.**

5. COURSE OUTCOMES (CO's) at the end of course students will be able to: -

CO. No	COURSE OUTCOME
CO1	Apply the basics of measurement to the measuring instruments
CO2	Measure precisely current and voltage using instrument transformers
CO3	Use appropriate instrument for measurement of resistance
CO4	Select suitable bridge for measurement of inductance, capacitance and frequency
CO5	Calibrate and choose instrument used for measurement of power and energy
CO6	Use digital measuring instruments for different applications

6. CO-PO, CO-PSO MAPPING TABLE

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Electrical and Electronic Measurements (EEM230311)	CO1	3	1	-	1	-	1	1	2	2
	CO2	3	2	1	2	1	1	2	2	3
	CO3	3	2	2	2	1	1	3	3	2
	CO4	3	2	1	2	2	1	2	2	2
	CO5	3	1	1	2	2	1	2	2	3
	CO6	3	2	-	3	2	-	-	2	2
	CO Avg.	**3.00**	**1.67**	**1.25**	**2.00**	**1.60**	**1.00**	**2.00**	**2.00**	**3.00**

7. COURSE CONTENTS

Unit No.	Topic/Sub-Topics	CO	Hours
I	**1.0 Basics of Measurements and Measuring Instruments** 1.1 System of units, standards and dimensions 1.2 Types of standards, Primary & Secondary standards for voltage, current and resistance. 1.3 Classification of Analog instruments 1.4 General Features of Indicating, recording & integrating instruments. 1.5 Torque acting on the moving system of indicating instruments. 1.6 Method of damping & damping curve 1.7 Calibration: Need, significance and general procedure 1.8 Principle of operation, Equation for deflecting torque, Usual scale distribution & its modifications, Sources of errors, remedies for errors & common usage of the following type of instruments 1.8.1 Permanent magnet moving coil instruments 1.8.2 Moving iron instruments 1.8.3 Electrodynamics or dynamometer type instruments 1.8.4 Induction instruments 1.8.5 Rectifier instruments. 1.9 Series register, shunts, universal shunts, multiplying power of a multiplier. Simple Numerical	**CO1**	**09**
II	**2.0 Instrument Transformer.** 2.1 Construction of Current transformers and potential transformers 2.2 Types of CT with specifications 2.3 Advantages of instrument Transformers over Shunts and Multipliers 2.4 Phasor diagram, phase angle, phase angle error, ratio error 2.5 Methods to minimize it. Simple Numerical	**CO2**	**06**
III	**3.0 Resistance Measurements.** 3.1 Classification of resistance as low, medium & high resistance 3.1.1 Voltmeter & ammeter method, 3.1.2 Substitution method, Potentiometer method	**CO3**	**08**

	3.2 Bridge method –Wheatstone's bridge 3.2.1 Limitations of Wheatstone's bridge, 3.2.2 Kelvin double bridge for low resistance. 3.2 Measurement of earth resistance using earth tester 3.3 Measurements of high resistance. (Insulation Resistance) 3.3.1 Surface leakage & Guard Circuit 3.4 Measurements of high resistance by loss of charge method. 3.5 Ohm –meters, series type shunt type and Megger 3.6 Mega ohm bridge 3.7 Measurement of Earth Resistance 3.7.1 Fall of Potential Method 3.7.2 Earth Tester: Construction and Working Simple Numerical		
IV	**4.0 A.C Bridges.** 4.1 General theory of A.C Bridges 4.2 Different sources and detectors used for bridge circuits. 4.3 Different bridge networks, their balance equations & phasor diagrams under balanced conditions of 4.3.1 Maxwell's L- and L-C Bridge 4.3.2 Anderson bridge 4.3.3 Wein bridge, 4.3.4 Schering bridge – low voltage & high voltage bridge, Quality Factor , Dissipation factor and Loss angle	**CO4**	**06**
V	**5.0 Measurement of Power and Energy** 5.1 Power measurement using 5.1.1 Electrodynamics type 5.1.2 Induction type wattmeter 5.2 Measurement of three phase power 5.2.1 One wattmeter method 5.2.2 Two-wattmeter method for balance and unbalanced loads and star and delta connection. 5.3 Variation of the ratio of the wattmeter reading against the power factor of the load. 5.4 Measurement of reactive power for balanced load. 5.5 Poly-phase wattmeter. 5.6 Measurement of energy using analog Energy meter 5.6.1. Principle of operation, 5.6.2 Equation for torque, 5.7 Different adjustment in ac energy meter. 5.8 Block Diagram, Construction features and working principle of Electronic energy meter 5.9 Introduction to poly-phase energy meter. 5.10 Smart energy meter: Basic concept, block diagram, operation and working principle. 5.11 Calibration of single phase energy-meter with various types of loads by direct loading. Simple Numerical	**CO5**	**08**

VI	**6.0 Electronic Instruments.** 6.1 Digital measuring Instruments-Essentials and advantages 6.2 Construction, Block Diagram and working of 6.2.1 Digital multimeter 6.2.2 Digital L-C-R Meter. 6.2.3 Digital Tachometer, 6.2.4 Digital frequency meter 6.2.5 Digital Storage oscilloscope. 6.3 Measurement of Time, Frequency & phase angle measurements using CRO	**CO6**	**06**
	Total Hours		**45**

8. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISE/TUTORIALS/DRAWINGS

The term work consists of journals consisting of minimum 8-10 experiments and 3-4 assignments with approx. number of hours required with corresponding CO's

Sr.No	Title of Experiments/Assignments/Exercise/Tutorials/Drawings	Approx Hrs. Required	CO
1	Identify the constructional details of analog ammeter /voltmeter/Wattmeter	02	CO1
2	Study of CT & PT construction working and applications	02	CO2
3	Measurement of medium Resistance using Wheatstone bridge method	02	CO3
4	Measurement of Insulation resistance using Loss of Charge method	02	CO3
5	Measure unknown inductance using Maxwell's Bridge	02	CO4
6	Measure unknown inductance using Andersons Bridge	02	CO4
7	Measure unknown Capacitance using Schearing Bridge	02	CO4
8	Measure unknown frequency using Weins Bridge	02	CO4
9	Calibration of DC analog/Digital energy-meter.	02	CO5
10	Calibration of AC single-phase electronic energy meter by direct loading.	02	CO5
11	Measurement of three phase power by one wattmeter method	02	CO5
12	Measurement of three-phase power by two-wattmeter method.	02	CO5
13	Verify of the ratio of two-wattmeter reading against power factor	02	CO5
14	Measurement of reactive power using one wattmeter method	02	CO5
15	Measurement of supply voltage, frequency, peak value in single-phase circuit using CRO/DSO.	02	CO6
TOTAL		**30**	

9 SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITES FOR SPECIFIC LEARNING SKILL DEVELOPMENT (SELF LEARNING)

Assessment to be based on one of the following tools and rubrics for evaluation of SLA to be well defined by course teacher.

1. **Assignment:**
   - Identification of measuring instruments on the basis of symbols on dial, type, accuracy, class, position and scale.
   - Compare analog and digital meters.
   - Compare PMMC with PMMI meters.
   - Determine earth resistance using digital earth tester and compare with the ideal earth resistance.
   - Compare analog with digital energy meter.

2. **Suggested Student Activity**
   - Prepare chart showing real-life examples indicating various types of electrical measuring equipment.
   - Collect photographs of PMMC and MI instrument showing internal parts.
   - Prepare power point presentation for different types of wattmeters.
   - Collect photographs of electronic energy meter and prepare report on it.
   - Prepare the report on smart energy meter.
   - Collect photographs of CRO and see the practical utilization.

10. IMPLEMENTATION STRATEGY: (PLANNING)

1. Teaching plan
2. Minimum no of Practical's/Assignments
3. Industrial Visit
4. Guest/Expert Lectures
5. Demonstrations
6. Slides
7. Continuous assessment for lab works
8. Self-learning Online Resources

11. SUGGESTED LEARNING RESOURCES:

Sr.No.	Title of Book	Author	Publication
1	Electrical measurements and Instrumentation	A.K.Shawney	Dhanpatrai& sons, New Delhi ISBN:9780000279744
2	Electrical Measurements & Measuring Instruments	N.V Suryanarayana	S Chand & Co, New Delhi ISBN: 8121928116
3	Electrical Measurements	C.T.Baldwin	Lyall book Dept. Delhi
4	Electrical Measurements & Measuring instruments	E.W. Golding, F.C. Widdis	Reem publications New Delhi, 2011
5	Electrical and Electronics Measurements & Instrumentation	R K Rajput	S Chand & Co, New Delhi ISBN: 9789385676017
6	A course in electronics & electrical measurement & instrumentation	J.B. Gupta	S.K. Kataria and Sons, New Delhi, 2011

12. LEARNING WEBSITE & PORTALS

1. https://www.electrical4u.com/
2. www.ni.com/labview
3. https://electricalandelectronics.org/
4. www.electrical-electronics.co.in
5. https://www.electrical4u.com/

13. ASSESMENT METHODOLOGIES/TOOLS

Formative Assessment (Assessment for Learning)

1. Test – **Not Applicable**
2. Rubrics for COs Assignment
3. Self-Learning
4. Term Work

Summative Assessment (Assessment of Learning)

1. End Term Exam (PR- Only)

14. COURSE EXPERT COMMITTEE MEMBERS:

Sr.No		Name
1.	Internal	Shri N D Adate
2.	Internal	Mrs. A N Kinhekar
3.	External	Dr. B B Sul
		Organization : G P Mumbai,